

Oil Policy

The Rimini Protocol Revisited

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Abstract

The First Half the Oil Age saw the rapid expansion of just about everything, fuelled by cheap and easy energy. But oil and gas are finite natural resources formed in the geological past meaning that they are subject to depletion. The Second Half of the Oil Age will therefore see a corresponding contraction. This paper reviews the nature of oil and gas and the politico-economic factors affecting the reporting of reserves. It touches on the personal experiences of the author who some years ago suggested that countries should cut consumption to match world depletion rate under the so-called Rimini Protocol, which has since attracted interest in some countries.

Keywords

Peak Oil; Oil Depletion; Oil Politics and Economics

Introduction

A fascinating book *Merchant, Soldier, Sage – A New History of Power* (Priestland 2012) explains the evolving roles of these elements in the history of countries and communities. It is very relevant to the current situation. Oil and gas fuel the modern economy but are natural resources formed in the geological past, meaning that they are subject to depletion. The evidence suggests that we are about half way through the Oil Age. The *First Half* saw the rapid expansion of just about everything, allowing the population to expand six-fold, and logic suggests that the *Second Half* may see a corresponding contraction. The *Rimini Protocol*, whereby countries would cut consumption to match world depletion rate, was a proposal designed to meet the unfolding situation. This paper will endeavour to review the background from a personal standpoint.

Personal Background

By the time this is published, I will have reached the great age of 82, meaning that I have had a personal view of the unfolding history of modern times which is perhaps worth covering. I was eight years old when the Second World War broke out but still have clear

memories of conditions in England which are relevant to what now unfolds. Private motoring had virtually ceased but there were rural buses. I remember that the headmaster of my boarding school had a large black car which pulled a trailer containing a stove that produced methane from burning wood, sufficient to power the car. We had food rationing but supplemented the diet with eggs from our chickens, vegetables from the garden and blackberries collected in the woods. There was no central heating but we kept warm with wood fires. Shops continued to provide minimal needs with survival being seen as more important than expansion. There were a few profiteers around trying to make quick money from situations, but were widely condemned, being known as *spivs*. In other words, people developed a strong cooperative attitude in a society under strict but benign government control: the country in fact lived for ten years without elections. These few words describe the reaction to war which may surface again during the Second Half of the Age of Oil.

In 1951, I went to Oxford to read geology followed by a D.Phil covering research based on mapping the hills of Connemara in the west of Ireland and the Usun Apau area in central Borneo, to which I went on a university expedition. When these happy days came to an end I joined the oil industry as a field geologist in Trinidad and, later, Colombia, where I had some colourful experiences in remote Andean regions, camping with my field crew and using mules for transport. In 1966, I was told to compile a report on the geology and oil prospects of Colombia, prior to transfer. I investigated the many different geological basins, recording the number of exploration wells (*wildcats*) drilled and the size of discoveries made. Some basins were prospective and mature, whereas others lacked the essential geological characteristics. The good prospects for the Llanos Basin to the east of the Andes were evident but it was too remote to be attractive in economic terms with oil being then traded at no more than about \$12 a barrel (in \$2011).

In 1969, I found myself in the head office of an oil company in Chicago as part of a team making a world evaluation as a basis for exploration planning. I had responsibility for Latin America and found that the pattern I had already observed in Colombia applied in varying degrees to all countries. It opened my eyes to the finite nature of the resource and the fundamental issue of depletion which had a deep impact in both professional and personal terms. I realised that it was not simply a matter of economics, but that the underlying geology had a more fundamental role.

My career unfolded in the oil business around the world, ending as the Executive Vice-President of a company in Norway. My interest in depletion persisted and I arranged for my company to sponsor research into the subject by the Norwegian Petroleum Directorate. Various consultants were retained but we used official reserve data as published by the Oil & Gas Journal. The results led to my first book entitled *The Golden Century of Oil 1950-2050*. (Campbell, 1991) It attracted the interest of Petroconsultants in Geneva, which maintained the industry database using confidential information from the oil companies. They invited me to join Jean Laherrère, who had long experience with a French oil company, to write an updated version based on reliable information, which indicated that the resource base was larger than public data suggested. Although the report was later suppressed under pressure from an oil company, the essential results were published by the Scientific American in 1998 in an article entitled *The End of Cheap Oil*. (Campbell C.J. and J.H.Laherrère, 1998)

By then I had retired, if that is the word, but found myself asked to speak on the subject at conferences, also having many media interviews, and writing six more books on the topic (see references). I also helped form the *Association for the Study of Peak Oil and Gas* ("ASPO") which now has affiliates in more than thirty countries. It has helped draw attention to the subject which now attracts much academic and official interest, although vested interests remain in denial.

Petroleum Geology

The foregoing describes my personal exposure to this critical issue, the nature of which is summarised below.

Oil and gas are finite natural resources formed in the geological past under now well-understood processes. Algae and other organic material proliferated at times

of global warming, and accumulated in stagnant lakes and seas that formed in rifts where the continents moved apart on the back of deep-seated convection currents in the Earth's Crust. The surface waters were heated such that circulation ceased leading to anoxic conditions at depth, under which the organic material was converted into *kerogens*, some being oil prone and others gas prone, depending on the precise composition of the organic material. Much of the world's oil comes from just two epochs of global warming, 90 and 150 million years ago. The rifts were progressively filled by sediment washed in from the erosion of the adjoining continents, and when the *kerogens* were buried to a depth of about 2000m they were heated enough to be converted into oil or gas. Furthermore, oil was converted into gas where over-heated on deep burial.

Once formed, the oil and gas tended to migrate upwards to zones of lesser pressure, provided that it could find migration paths in the form of fissures or porous and permeable rocks. Some dissipated at depth, and some escaped at the surface, with the tar-sands of Canada being a well-known example. But locally the oil and gas were trapped in dome-like structures, called anticlines, and in other structural circumstances, provided that there were appropriate reservoirs and seals. Porous and permeable sandstone is the most common reservoir, with the oil and gas being held in the space between the grains of sand, while clay and salt form effective seals. Such accumulations in reservoirs are underlain by water and commonly overlain by a gas cap.

Oil and gas from surface seepages have been known since biblical times, but the development of the internal combustion engine around 1860 led to the birth of the oil industry. Early oil fields were found near natural seepages in Pennsylvania, Romania and on the shores of the Caspian. The Standard Oil Company came to dominate the business in the United States, but was broken up under anti-trust legislation in 1911, while Shell and BP based in Europe took positions in the Middle East, Mexico and Venezuela. Seven major companies, known as the *Seven Sisters*, came to control world oil supply.

It did not take long for the early explorers to understand the basic geological requirements for finding oil, mapping the rocks with technology no more advanced than a hammer, hand lens and notebook. The work called for both careful observation and logical imagination to piece together the underlying geology from isolated outcrops. Later, came geophysical technology whereby

an explosive charge was released, and recorders tracked the time taken for echoes to return from deeply buried rock surfaces, allowing the geology at depth to be mapped in detail. There were important geochemical advances to better understand the nature of source rocks, and the technology of drilling and production methods also saw radical improvements.

The more prospective provinces and the larger fields within them were found first for obvious reasons, being too big to miss. But gradually as the accessible onshore areas were exhausted the industry turned its attention to the offshore moving progressively into deeper waters where it faced greater technological and economic hurdles. Much of the planet is covered by oceans, but relatively few areas beneath them have the right geology to yield oil and gas, with the margins of the South Atlantic and the Gulf of Mexico being prime tracts. The Polar regions also attracted interest, yielding the giant Prudhoe Bay Field in Alaska, but it is not prime territory in geological terms partly because the crust has been subject to substantial vertical movements under the weight of fluctuating ice-caps which adversely affected entrapment and made it gas-prone.

Economics and Politics

The underlying nature of oil and gas resources is well understood, but the developments have naturally been much influenced by economics and politics. The oil companies were commercial undertakings motivated by profit, and governments commonly had reason to exercise a degree of control.

The discovery of a new oil province led to a glut of oil which depressed price with adverse financial consequences calling for partly political responses. One of the first moves was in 1928 when the *Seven Sisters* held a secret meeting at Achnacarry Castle in Scotland to agree to regulate production between themselves to support price. Then, the US Government moved in 1931, following major discoveries in Texas, to limit production to a given number of days a month in a policy administered by the Texas Railroad Commission. These were precedents for the formation in 1960 of the Organisation of Petroleum Exporting Countries ("OPEC"), whose members agreed to restrict production, based in part on reported reserves.

There were many other political factors. Russia expropriated its oil industry in 1928 and Mexico

followed ten years later. National companies were also established. In most countries, mineral rights are held by the Government which leases them out as concessions under stated terms, but in the United States onshore mineral rights are held by the landowner, which led the Stock Exchange to impose strict rules as to what could be reported as reserves for financial purposes. The international companies were subject to these same rules and came to find it expedient to report the minimum needed for financial purposes which delivered an attractive, if somewhat misleading, image of steady growth the Stock Market.

The Reporting of Production and Reserves

Determining the status of depletion of these finite natural resources involves the analysis of past production and the size of remaining reserves. It would be a relatively straightforward task were valid data publically available, which is far from the case. There are several different categories of oil and gas, each having its own costs, characteristics and depletion profile but there is no standard definition of the boundaries, which is a cause of much confusion. The following classification is used here:

1. *Regular Conventional Oil and Gas*: (A liquid, known as *condensate*, which naturally condenses from gas, is treated together with *Regular Conventional oil*).
2. *Heavy Oils*: with a density greater than 17.5° API, including bitumen.
3. *Oil Shale*: oil that can be produced by heating immature source-rocks.
4. *Tight Oil and Gas (also called Shale Oil and Gas)*: as derived from rocks lacking adequate natural porosity and permeability that can yield production when artificially fractured.
5. *Deepwater Oil and Gas*: in water depths greater than 500m.
6. *Polar Oil and Gas*.
7. *Natural Gas Liquids* from gas plants.
8. *Other Non-Conventional gases*: coalbed methane, hydrates etc.

Production data are relatively sound although war-loss, which is to be treated as production in the sense that it depleted the reserves by like amount, has not been reported at all. As much as 2 Gb (billion barrels) went up in smoke in the Kuwait War.

The assessment of the size of an oilfield evolves after discovery as appraisal wells are drilled. It became normal industry practice to recognise *Proved*, *Probable* and *Possible Reserves* with the meanings the words imply, accepting *Proved* in full, two-thirds of the *Probable* and one-third of the *Possible* as a reasonable total. The sum of *Proved* and *Probable*, known as 2P, are also widely used. Probabilistic methods have also been used with the *Mean* value being taken as the best estimate. Economic factors obviously play a role as higher prices can extend the life of a field and justify the technology needed to improve the percentage recovered from a reservoir, known as the *Recovery Factor*.

There is evidently a genuine range in the estimates that can change over time, but one of the principal causes of confusion was the OPEC reporting, which is significant because these countries supply almost 40% of the world's current needs. The main distortion came at a time of low oil prices in the 1980s when certain OPEC countries exaggerated the size of their reserves in order to raise their production quota, and thereby secure more revenue. In 1985, Kuwait increased its reported reserves from 64 to 90 Gb (billion barrels) although nothing particular had changed in its oilfields. The numbers suggest that this may have reflected a change to reporting *Original Reserves*, by not subtracting past production, rather than *Remaining Reserves*. Two years later, it announced a possibly

genuine small increase to 92 Gb, but that proved too much for its rivals. Abu Dhabi countered by matching Kuwait at 92 Gb (up from 31 Gb); Iran went one better at 93 Gb (up from 49 Gb); while Iraq capped both at 100 Gb (up from 47 Gb). Venezuela for its part increased from 25 to 56 Gb, but did so by including its *non-conventional* heavy oils that had not previously counted for quota purposes. Saudi Arabia could not match Kuwait because it was already reporting more, but in 1990 announced a massive increase from 170 to 258 Gb to hold its lead.

Building the Depletion Model

Despite the weaknesses of the public data it is possible to build a realistic model of the world's depletion profile. It is important to evaluate the status of each country's profile to identify the anomalies and uncertainties before summing them into regional and world totals. It also makes sense to treat everything in terms of production to the end of the Century as shown in the following table. It avoids having to worry about some irrelevant tail-end and evades the problems of *Reserve* reporting. The estimates are quoted in billion barrels (Gb). The barrel is the normal industry measurement, being equivalent to 42 US gallons or 159 litres. Naturally, all numbers should be generously rounded in view of the uncertainties of detail.

Regular Conventional Oil Production to 2100 (Gb)								
	WORLD	M. East	Eurasia	North America	Latin America	Africa	Europe	Asia-Pacific
PAST	1141	340	237	203	130	107	57	56
FUTURE	909	487	158	23	59	94	24	28
Known	794	444	130	21	51	83	21	26
Yet-to-find	114	44	29	3	8	11	3	2
TOTAL	2050	859	396	226	189	201	81	85
Peak date	2005	2021	2011	1973	1998	2005	1999	2000

(Note: as here defined, Eurasia comprises the former Communist bloc of the Soviet Union, Eastern Europe and China; and Mexico is included in Latin America. The individual regions comprise the major producers in each region. The world estimates include the sum of additional minor countries. For details, see Campbell's Atlas of Oil and Gas Depletion, 2013)

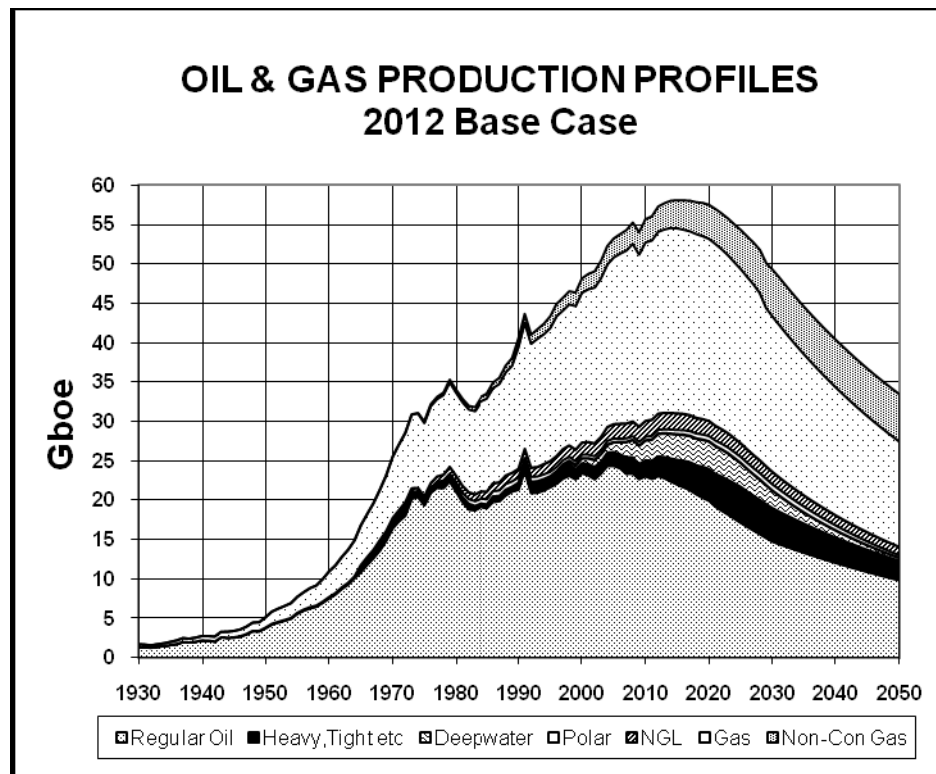


FIG. 1 OIL & GAS PRODUCTION PROFILES 2012 BASE CASE

The depletion model assumes that a country's production begins to decline at the midpoint of depletion when half the Total has been produced, and does so at the then *Depletion Rate*, namely annual as a percentage of future. Departures from this rate may be expected for all sorts of above-ground reasons but the model self-adjusts with anomalous rates being reflected in the subsequent depletion rate. More than fifty countries are now producing less than at some date in the past, some being long into decline. For countries not yet at midpoint, it is necessary to take into account local circumstances, but most such countries are close to midpoint so the assumptions do not have much impact on the world picture. Increased attention is now being given to *Non-Conventional oil and gas*, especially *Tight Oil and Gas* from so-called frac-ing. The artificial fracturing of rocks lacking adequate natural porosity and permeability is a long-established practice, but the recent high prices and other technological developments have facilitated its application. The wells are costly and have short lives, suggesting that production is likely to ameliorate the decline having little impact on peak production itself. The overall picture is illustrated in the above figure.

Oil Prices

Oil prices were high in the 1860s during the early days of production, but then progressively declined to less

than \$20 a barrel over most of the last century as measured in terms of present-day dollars. Then came the First Oil Shock of 1979 when Kuwait, Saudi Arabia and Libya restricted exports in response to the support for Israel by the United States and other countries. It was followed by the Second Oil Shock, occasioned by fears associated with the fall of the Shah of Iran. Prices surged briefly to \$100 a barrel but then declined to below \$40 for the remainder of the last century. The market gradually became aware of the depletion of oil leading shrewd traders to speculate on the Futures Market, which drove up prices to almost \$150 by mid-2008. The scale of speculation is indicated by the size of *Futures Contracts*, which exceeded actual production by factors of ten to thirty (Tolub and Erb, 2010). The high prices led to a financial crisis and economic recession causing demand to fall. This was also spotted by the traders who started selling short on the Futures Market. The reduction in demand led to a brief fall in prices, but they have since rebounded to above \$100 as the underlying impact of depletion becomes more widely perceived. There has indeed been a proliferation of scientific and other papers on the subject, with the principal authors being listed in the References, and growing media interest

In principle, prices should relate to the actual costs of production, which in the Middle East still may fall in the \$20-30 range. So, in a sense, the high prices reflect

profiteering from shortage, giving inflationary pressures.

It is difficult for governments to come to terms with such a fundamental change in circumstances, but there are signs of an awakening as discussed in connection with the Rimini Protocol below. Of significance in this connection is a report published in 2012 by the International Monetary Fund that gives equal weight to the analysis described herein as to those from official institutions.

The Rimini Protocol

The foregoing explains the nature of depletion and the difficulties in assessing the precise status. A debate rages as to the precise date of *Peak Production* but misses the point when what matters is the vision of the long decline that comes into sight on the other side of it. Oil and gas play a central part in the modern world including the agriculture needed to feed the current population. The transition to the *Second Half of the Oil Age* threatens to be a time of great tension as indeed is already being observed with riots, revolutions and acts of terror around the world. High levels of unemployment, especially for the relatively young and the immigrant communities, has sparked deep resentment giving rise to violent outbursts, even recently in Sweden.

I have tried to address the situation and think of solutions. I went to a conference in London in 1995 organised by the Centre for Global Energy Studies, which had been founded by Sheik Yamani, the former Oil Minister of Saudi Arabia. They asked me to not only address the problems but to come forth with ideas for solutions. It did not take long to conclude that the simplest solution would be for countries to voluntarily cut consumption to match the available supply - a suggestion on which I ended my talk. It happened that the then Secretary of OPEC was in the audience, and rose to support the idea.

Not long afterwards Professor Aleklett, who had become interested in the subject, invited me to Uppsala University in Sweden to give a talk. By now I had formalised the proposal to cut demand, and named it the Uppsala Protocol. Then in 2003, I was invited by the Pio Manzu Institute to give a talk at a conference being organised in Rimini in Italy on this general theme. I renamed the protocol as the Rimini Protocol for the conference. The Mayor of Rimini was delighted thinking that his city might become as famous as Kyoto. It was indeed an impressive conference,

attended by several important figures from the Middle East, attracting much media attention. (See the Appendix for a draft of the proposed protocol).

There were many subsequent conferences and meetings, including presentations to the European Commission, the British Parliament and the Irish Senate. At one of them in Cork, Ireland, I met Richard Heinberg who was addressing the issue in the United States. In 2006, he wrote a book entitled *The Oil Depletion Protocol*.

It is a simple concept proposing that countries shall use their foreign services to collect information by which to determine what the world depletion rate truly is, and then adopt policies to cut their demand to match it. The current depletion rate for *Regular Conventional Oil* is running at no more than about 2.5% a year, so it should be possible to cut consumption by that amount without too serious an impact on the economy although such a radical shift in policy would pose difficult political challenges. There is plenty of scope for improving energy efficiency. The details of the Protocol need more attention, possibly addressing imports and exports as well as the different categories of oil that might be treated differently from each other.

It is encouraging that the Portuguese Parliament has now passed a resolution urging its government to adopt it, and that it has also become a central policy theme for a new party in Galicia in Spain. It is probably unrealistic to expect all countries to sign up, but those that do would soon find themselves having a great advantage.

Conclusions

It is evident that the easy energy from oil and gas fuelled an expanding economy over the past century. This in turn encouraged the so-called merchant behaviour discussed by Priestland (2012). Making money by whatever means possible became the central objective for most societies. Trading empires developed, backed in turn by financial empires controlled by a few well-known names. But it was not plain sailing as conflicts and tensions arose over spheres of interest prompting two world wars followed by the co-called Cold War.

The onset of the decline of these critical supplies of energy will likely mark a radical change in behaviour, and the transition threatens to be an epoch of great tension. *Petroleum Man* will be virtually extinct by the end of the Century. Already some producing countries, led by Argentina, have restricted exports to retain as

much as possible for their own future, and even King Abdullah of Saudi Arabia has said that wishes to leave as much wealth as possible in the ground for his grandsons. It makes eminent national sense although offending the principles of globalism, whereby the resources of any country are supposed to go to the highest bidder under free market principles.

But gradually there may be an awakening to the underlying causes, which are imposed by Nature, prompting positive responses. A new more benign age may dawn for the survivors as people revert to live on whatever their particular region can support, developing a co-operative spirit with which to do so. If more widely adopted, the Rimini Protocol could become a useful mechanism by which to adapt to the changing circumstances. We may see a return of the *Sage* at the expense of the *Merchant*, although there are risks that the *Warrior* may intervene.

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Appendix: Rimini Protocol

WHEREAS the passage of history has recorded an increasing pace of change, such that the demand for energy has grown rapidly in parallel with the world population over the past two hundred years since the Industrial Revolution;

WHEREAS the energy supply required by the population has come mainly from coal and petroleum, such resources having been formed but rarely in the geological past and being inevitably subject to depletion;

WHEREAS oil provides ninety percent of transport fuel, is essential to trade, and plays a critical role in the agriculture needed to feed the expanding population;

WHEREAS oil is unevenly distributed on the Planet for well understood geological reasons, with much being concentrated in five countries bordering the Persian Gulf;

WHEREAS all the major productive provinces of the World have been identified with the help of advanced technology and growing geological knowledge, it being now evident that discovery reached a peak in the 1960s, despite technological progress and a diligent search;

WHEREAS the past peak of discovery inevitably delivers a corresponding peak in production during the first decade of the 21st Century, assuming no radical decline in demand;

WHEREAS the onset of the decline of this critical resource affects all aspects of modern life, such having grave political and geopolitical implications;

WHEREAS it is expedient to plan an orderly transition to the new World environment of reduced energy supply, making early provisions to avoid the waste of energy, stimulate the entry of substitute energies, and extend the life of the remaining oil;

WHEREAS it is desirable to meet the challenges so arising in a co-operative and equitable manner, such to address related climate change concerns, economic and financial stability, and the threats of conflicts for access to critical resources

NOW IT IS PROPOSED THAT

1. A convention of nations shall be called to consider the issue with a view to agreeing an ACCORD with the following objectives:

- a. to avoid profiteering from shortage, such that oil prices may remain in reasonable relationship with production cost;
- b. to allow poor countries to afford their imports;
- c. to avoid destabilizing financial flows arising from excessive oil prices;

- d. to encourage consumers to avoid waste;
- e. to stimulate the development of alternative energies.

2. Such an Accord shall have the following outline provisions:

- a. The World and every nation shall aim to reduce oil consumption by at least the world depletion rate;
- b. No country shall produce oil at above its present depletion rate;
- c. No country shall import at above the world depletion rate;
- d. The depletion rate is defined as annual production as a percent of what is left (reserves plus yet-to-find);
- e. The preceding provisions refer to regular conventional oil—which category excludes heavy oils with a cut-off of 17.5o API, deepwater oil with a cut-off of 500 meters, polar oil, gas liquids from gasfields, tar sands, oil shale, oil from coal, biofuels such as ethanol etc;

3. Detailed provision shall cover the definition of the several categories of oil, exemptions and qualifications, and the scientific procedures for the estimation of Depletion Rate;

4. The signatory countries shall cooperate in providing information on their reserves, allowing full technical audit, such that the Depletion Rate may be accurately determined;

5. The signatory countries shall have the right to appeal their assessed depletion rate in the event of changed circumstances.